



Portland Urban Tree Canopy Assessment 2018



Prepared by Project Canopy

Acknowledgements

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About Project Canopy

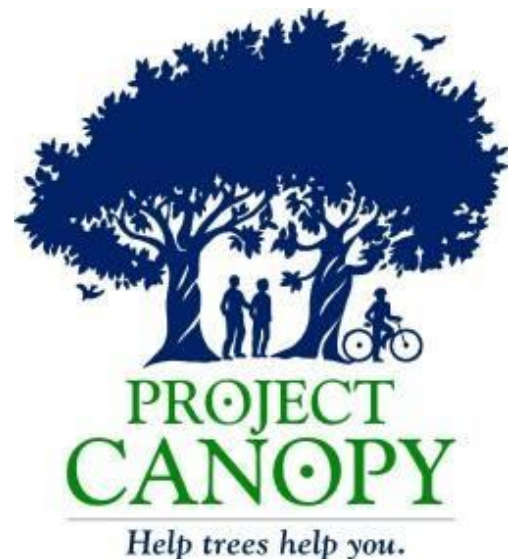
Project Canopy is Maine's urban and community forest program, a program of the Maine Forest Service under Maine's Department of Agriculture, Conservation and Forestry. It educates people about the benefits trees provide, and how trees make people's lives better. It connects people who have a particular expertise to people who need that expertise. It helps build bridges with town and city governments, and it knows how to communicate in a local, political environment. And just as important, Project Canopy helps people talk about success stories, so that they can find the motivation --- and inspiration --- that is crucial for developing creative, long-term community forestry programs.

The Maine Forest Service has an incredible reservoir of knowledge and expertise. The challenge for us is to get that knowledge to the people who can use it. Any long-term community forestry program needs commitment and understanding from many different corners. Project Canopy's role is to get people in different corners talking to each other, so that awareness about trees can grow by leaps and bounds. We do that by using down-to-earth strategies, and deploying technical experts into the field to lend hands-on assistance.

For example:

- Helping recruit and organize volunteers;
- Providing model community tree ordinances;
- Assisting in fund-raising efforts;
- Training tree stewards;
- Providing street tree inventory software;
- Helping communities appoint/elect a community tree warden;
- Linking communities to other Maine communities with successful tree programs;
- Providing lists of local foresters and arborists;
- Building bridges to national community tree organizations;
- Assisting in development of a long-term community tree plan;

And much more.



Summary

The goal of the Portland Urban Tree Canopy study was to accurately quantify the City's canopy cover and to identify areas where increased tree planting would be most beneficial. A complete and up-to-date inventory of street and public trees can serve as a baseline to determine maintenance needs, species diversity, locate available planting sites, and track individual tree conditions. With this information, Portland can update its management plan for its public trees that will serve its residents and businesses, as well as its visitors, now and into the future.

State and local government, City boards and committees, conservation agencies, and private landowners all play an important role in monitoring and maintaining urban forests. Public trees provide a number of benefits to a community, including reducing stormwater runoff, reducing air pollution, providing shade, sequestering carbon dioxide (CO₂), enhancing property values, and improving the aesthetics of the community. **The City's canopy cover of 23% provides an estimated \$874,390 in air quality benefits annually as well as an estimated long-term stored CO₂ value of \$15,610,923 to the residents and businesses of Portland.**

Forest Cover

- There is an existing urban tree canopy (UTC) cover of 23% on Portland's mainland.
- This aerial analysis was done using over 1000 data points within the approximately 18 sq. mi within mainland Portland city limits, encompassing both public and private land.
- Trees could be planted across an additional 27% of Portland's land surface. These "possible UTC" areas include low-lying vegetation or grassland, and some currently impervious surfaces (e.g. parking lots).
- The remaining 50% of Portland's land area is buildings, roads, bodies of water and other permanent features and is generally unsuited to UTC improvement.



Introduction

Project Description

Portland, Maine has earned its spot on numerous top ten lists in recent memory: most livable, happiest city, most learned, prettiest, most hipsters(?). A revitalized arts district, influx of James Beard Award winning chefs, and the increasing trend in telecommuting has helped to create a population boom in Maine's largest city. Interstates 95 and 295 as well as US Route 1 transect the city, shuttling commuters, students and cargo through rural stretches and over tidal flats, bypassing neighborhoods of historic homes, industrial facilities and sprawling commercial strips.

Portland most recently updated its Comprehensive Plan in 2017. Included in this plan are goals to identify and protect Portland's critical natural resources; support agricultural, forest, and scenic resources appropriate to our urban context; develop climate resilience through specific carbon reduction goals, comprehensive climate adaptation strategies, and protections for the city's most vulnerable infrastructure; make physical improvements and expansions to below- and above-grade infrastructure, including utilities, stormwater, transit, parking, and streets, to maintain and accommodate new growth; support reduction in impervious surfaces and implementation of green infrastructure in local codes, through incentives, and in infrastructure investments where appropriate; and increase the urban tree canopy by 15% above current canopy coverage to benefit air quality, local climate, CO2 absorption, and aesthetics.

Project Canopy partnered with the City and Oakhurst Dairy in the Spring of 2018 to conduct an Urban Tree Canopy (UTC) assessment of the City, thereby providing it with a component that will assist in achieving many of these goals. Utilizing this report to contribute to and update the current urban forest management plan will set Portland on a path to maintaining and increasing a healthy robust population of public trees that will pay it forward for decades to come. Incorporating a forest pest management plan as a component of this larger plan will establish a baseline and protocol to follow when invasive insects such as the emerald ash borer (EAB) and Asian longhorn beetle (ALB) threaten Portland's trees.

City Profile

The City of Portland, in Cumberland County, is located in Southern Maine, part of the Casco Bay Watershed. In 2017 the City's population reached over 67,000, making it the state's largest municipality. It is easily accessible from Interstate 95 and 295 and is less than a day's drive from Boston, New York and parts of Canada. Portland hosts the University of Southern Maine as well as headquarters for Oakhurst Dairy, WEX and TD Bank, and its burgeoning arts, food and tech scene, coupled with improvements to mass transit will ensure that its population will continue to rise.

Much of Portland lies along two high speed 2-4 lane interstates (95 and 295) and is a major thoroughfare for traffic headed north. Traffic can be very heavy and travel at speeds surpassing 80 mph. Land around these highways are controlled and maintained by Maine DOT and the Maine Turnpike Authority. US Rt 1, the Eastern Promenade and Baxter Blvd carry residents and tourists alike along the coast, while state routes 302, 22 and 25 allow commuters access to the downtown from the west. Small stands of mature eastern white pine and northern red oak dot the landscape along the outer reaches of the main roads, but much of the gateway streetscape is commercial or residential with limited tree canopy.

The “Forest City” boasts 721 acres of open space and public parks, which provide cooling respite from the surrounding hardscape as well as recreational opportunities. Thanks to a long lineage of City Arborists, much of Portland’s historic downtown is host to shaded streets lined with mature oaks and maples, hardy ginkgos and crabapples, and fragrant honey locust and lindens. In 2013, the city conducted a complete inventory of its 20,000 public trees which can be viewed at: <http://portlandme.maps.arcgis.com/apps/webappviewer/index.html?id=8c1f329f45384c1080608df88501bcbe>

Portland has been recognized by the Arbor Day Foundation as a Tree City USA for 39 years. The Tree City USA program is designed to recognize those communities that effectively manage their public resources, and to encourage the implementation of community tree management based on four standards. These four standards provide structure for a community forestry program, require that program to demonstrate success based on the judgment of the state forester’s office, and provide for an awareness and appreciation of trees among the residents of the community.

Methodology

In the summer of 2018, Project Canopy staff completed a thorough UTC assessment of Portland, subdivided into 2 zones; “The Peninsula” - the land area bounded by Casco Bay, Back Bay, and 295, and NorthWest Portland, encompassing the remainder of the city north and west of 295. The inventoried land area was approximately 18 square miles, comprising all of mainland Portland.

Project Canopy staff utilized i-Tree Canopy to complete the UTC assessment to determine the total canopy cover as well as potential for additional planting. Over one thousand points of data in each zone were analyzed to extrapolate an estimated canopy cover with a margin of error less than 1.6%.

i-Tree is a free, easy-to-use software suite developed by the USDA Forest Service (www.itreetools.org). i-Tree Canopy uses aerial imagery, randomly generated map points and user-defined land cover types to produce an estimate of land cover of a

defined area - including tree canopy cover - that encompasses both public and private property. This tool also assigns dollar values to the benefits associated with the overall tree canopy cover. The aim of this type of assessment is to help citizens and decision-makers better understand the existing and potential tree canopy in their community.

Results

Based on Portland's i-Tree Canopy assessment, approximately 23% of the land area is currently occupied by tree canopy (See Appendix for results broken down by zone). Currently 50% of the total area is occupied by buildings and other non-plantable areas (parking lots, roads and bodies of water), however, some of this could be converted to tree canopy – such as tree islands and buffer strips in parking lots as well as green roofs. **Portland's canopy cover could potentially increase by more than 27% on open lands of low-lying vegetation and re-engineering of some parking lots.**

There are a multitude of spots in which substantial trees can be planted – particularly along Warren Ave, Forest Ave, Riverside St, Outer Congress St, and with modified tree pits and alternate methods of ice melt – throughout the Old Port. In 2012, the City of Portland adopted a Complete Streets policy and the 2017 Comprehensive plan lists the following as a goal: “Adopt sustainable land use and transportation policies that support connectivity, walkable neighborhoods, and multi-modal transportation”. Complete streets include trees and can easily be incorporated into existing or newly designed esplanades or sidewalk tree pits.

The City's canopy cover of 23% provides an estimated **\$874,390 in air quality benefits annually** as well as an estimated long-term stored CO₂ value of **\$15,610,923** to the residents and businesses of Portland.

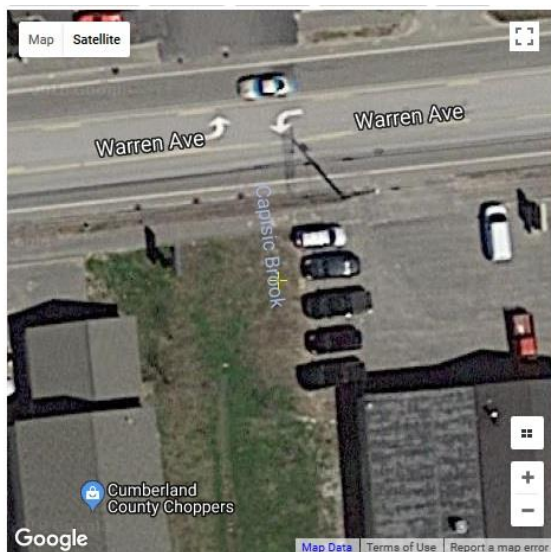


Figure 1. Examples of potential planting locations

Discussion and Recommendations

A UTC study is a quick and easy way to determine a municipality's urban canopy cover, discover new planting locations and quantify how its trees clean our air. Using a random sample method and based on assessing land cover types, i-Tree Canopy allowed us to measure the overall tree canopy cover within Portland capturing both private and public tree canopy totals. This study was able to put dollar values to:

- Air quality: **Trees improve air quality** by removing air pollutants through their leaves, altering emissions from building energy use, and by lowering air temperature.
- Stored carbon and sequestered carbon dioxide: Trees store carbon in their tissues as they accumulate biomass over time; an estimated 770 million tons of carbon, valued at \$14.3 billion, is stored in the public forests in the contiguous United States. Trees also mitigate greenhouse gas emissions by sequestering carbon dioxide through the process of photosynthesis.

As canopy increases, these benefits and savings will only increase. The trees of Portland also provide other services to the town in the following ways:

- Aesthetics: Trees can make an urban or suburban environment a more pleasant and satisfying place to live, work, and spend leisure time. In economic terms, presence of particularly mature shade trees can **significantly increase property value**. There are also **numerous health benefits** associated with the mere presence of trees. For example, hospital patients with window views of trees have been shown to recover faster than patients without such views.
- Energy use: Trees influence temperature and energy use by providing shade, transpiring moisture, and reducing wind speeds, **mitigating the need for heating of buildings in the winter and cooling in the summer**.
- Storm water run-off: Trees and soil **improve water quality and reduce costs** associated with stormwater treatment by retaining or slowing flow of rain and snow-melt.
- Benefits to retail businesses: **People shop more often, longer in well-landscaped areas** & will pay up to 12% more for parking and goods/services

We recommend that Portland's City Manager and Council members explore the results of the i-Tree assessment detailed in this report and:

- Use the information generated through i-Tree Canopy to promote the understanding of tree benefits and the investment in urban forest management and local stewardship.
- Use the i-Tree Canopy UTC and land cover assessment to inform and promote efforts towards an overall urban canopy cover of 40% (up from the current

23%). This might include outreach to private property owners to communicate tree benefits and encourage tree planting on their land.

- Update the inventory of public trees in Portland to include newly planted trees, and reassess the health and maintenance needs of established trees, thereby quantifying the value of all the benefits its trees provide.
- Work with Project Canopy staff to update the existing management plan based on the results of the inventory to prioritize goals and establish a timeline for the program.

Conclusion

Trees in our downtowns and commercial landscapes contribute to a thriving economy, promote our sense of community, protect our natural resources, preserve our cultural heritage, and increase our overall well-being. Well-planned and planted trees calm traffic, boost retail sales, reduce stormwater fees, provide cooling shade for parking lots and buildings, and create a visual gateway welcoming visitors to the destination of Portland. Larger shade trees can also provide heating and cooling savings to homes and businesses. This report is one component of an effort by the City of Portland to understand, manage, and steward its public tree population. The recommendations outlined in this report are based on Project Canopy staff's observations and data analysis combined with their experience and evaluation; they should be considered by Portland's leadership based on long-term vision and capacity.

Looking ahead, Portland should focus efforts on increasing the number of forestry staff, updating the full urban tree inventory, updating its management plan including a forest pest management component for the public tree population, planting new trees along the streetscapes, maintaining the quality of its mature trees in the neighborhoods and rural stretches, increasing its genera and species diversity, and increasing total canopy cover. With continued monitoring, regular maintenance, and an engaged and informed citizenry, the potential for a healthy, sustainable urban forest is attainable.



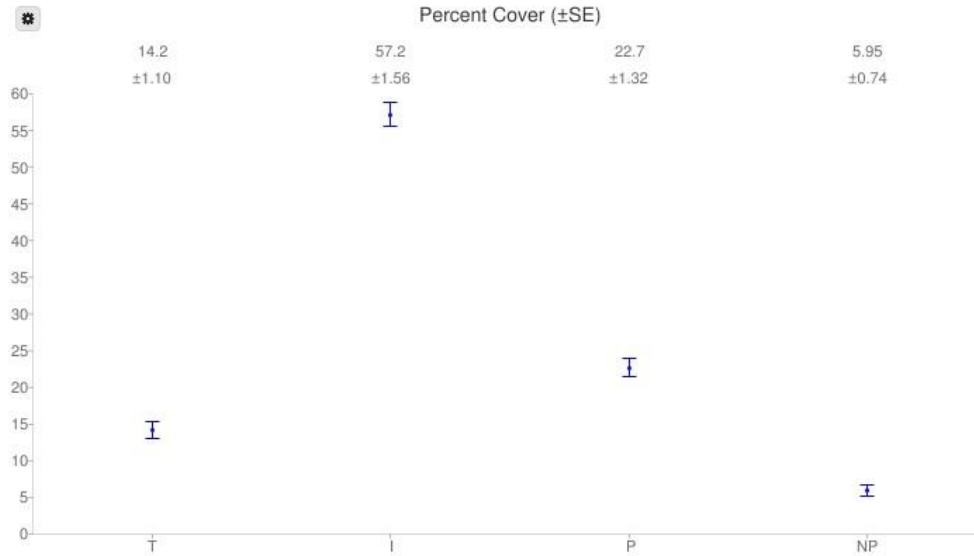
Appendix - Results by Zone

Peninsula:

i-Tree Canopy v6.1

Cover Assessment and Tree Benefits Report

Estimated using random sampling statistics on 7/05/18



Cover Class	Description	Abbr.	Points	% Cover
Tree	Tree, non-shrub	T	143	14.2 ±1.10
Impervious	road, building	I	577	57.2 ±1.56
Plantable area	Potential space for new trees	P	229	22.7 ±1.32
Pervious non-plantable	water, ballfields, etc	NP	60	5.95 ±0.74

Tree Benefit Estimates

Abbr.	Benefit Description	Value (USD)	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	\$145.20	±11.25	218.54 lb	±16.93
NO2	Nitrogen Dioxide removed annually	\$259.53	±20.11	1.00 T	±0.08
O3	Ozone removed annually	\$12,455.99	±964.99	6.14 T	±0.48
PM2.5	Particulate Matter less than 2.5 microns removed annually	\$32,681.79	±2,531.93	725.70 lb	±56.22
SO2	Sulfur Dioxide removed annually	\$34.39	±2.66	687.62 lb	±53.27
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	\$13,086.95	±1,013.87	2.10 T	±0.16
CO2seq	Carbon Dioxide sequestered annually in trees	\$31,215.85	±2,418.36	885.42 T	±68.60
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	\$1,086,198.56	±84,150.09	30,809.44 T	±2,386.87

i-Tree Canopy Annual Tree Benefit Estimates based on these values in lbs/acre/yr and \$/T/yr: CO 0.892 @ \$1,333.50 | NO2 8.175 @ \$259.97 | O3 50.093 @ \$2,036.17 | PM2.5 2.961 @ \$90,389.14 | SO2 2.805 @ \$100.37 | PM10* 17.096 @ \$6,268.44 | CO2seq 7,224.756 @ \$35.38 | CO2stor is a total biomass amount of 251,395.359 @ \$35.38

Note: Currency is in USD

Note: Standard errors of removal amounts and benefits were calculated based on standard errors of sampled and classified points.

About i-Tree Canopy

The concept and prototype of this program were developed by David J. Nowak, Jeffery T. Walton and Eric J. Greenfield (USDA Forest Service). The current version of this program was developed and adapted to i-Tree by David Ellingsworth, Mike Binkley, and Scott Maco (The Davey Tree Expert Company).

Limitations of i-Tree Canopy

The accuracy of the analysis depends upon the ability of the user to correctly classify each point into its correct class. As the number of points increase, the precision of the estimate will increase as the standard error of the estimate will decrease. If too few points are classified, the standard error will be too high to have any real certainty of the estimate.

A Cooperative Initiative Between:

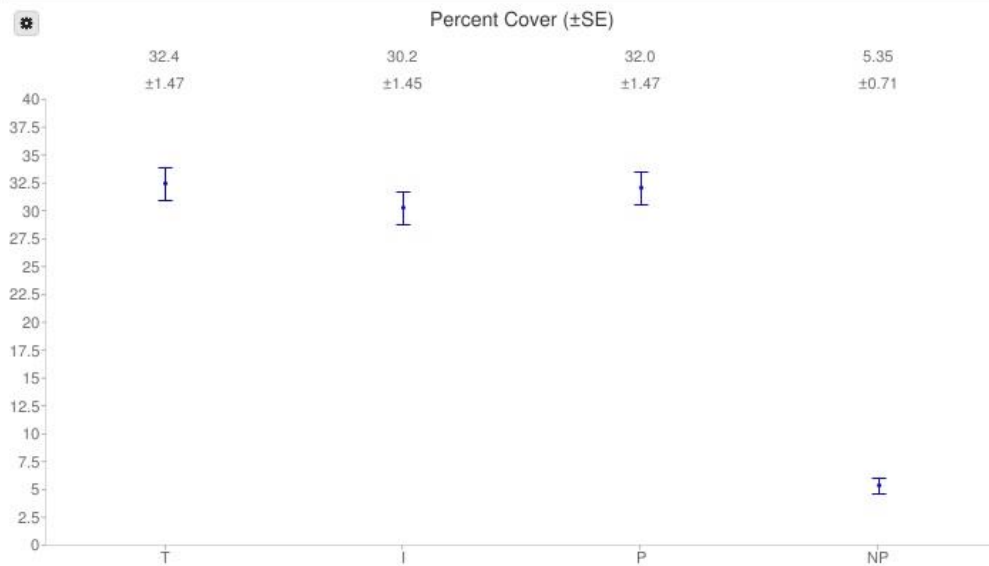


NW:

i-Tree Canopy_{v6.1}

Cover Assessment and Tree Benefits Report

Estimated using random sampling statistics on 7/06/18



Cover Class	Description	Abbr.	Points	% Cover
Tree	Tree, non-shrub	T	327	32.4 ±1.47
Impervious	roof, road	I	305	30.2 ±1.45
Plantable area	Potential area for new trees	P	323	32.0 ±1.47
Permeable non-plantable	water, ballfields, etc.	NP	54	5.35 ±0.71

Tree Benefit Estimates

Abbr.	Benefit Description	Value (USD)	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	\$1,941.75	±88.28	1.46 T	±0.07
NO2	Nitrogen Dioxide removed annually	\$3,470.69	±157.79	13.40 T	±0.61
O3	Ozone removed annually	\$166,573.88	±7,573.20	82.10 T	±3.73
PM2.5	Particulate Matter less than 2.5 microns removed annually	\$437,053.32	±19,870.42	4.85 T	±0.22
SO2	Sulfur Dioxide removed annually	\$459.84	±20.91	4.60 T	±0.21
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	\$175,011.64	±7,956.82	28.02 T	±1.27
CO2seq	Carbon Dioxide sequestered annually in trees	\$417,449.29	±18,979.14	11,840.73 T	±538.33
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	\$14,525,724.45	±660,405.27	412,014.45 T	±18,732.04

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A Cooperative Initiative Between:



Total Benefits:

Benefit	Peninsula		NW		Total	
	value	amt (lb)	value	amt (lb)	value	amt (lb)
CO	\$145.20	218.54	\$1,941.75	2,920.00	\$2,086.95	3,138.54
NO2	\$259.53	2,000.00	\$3,470.69	26,800.00	\$3,730.22	28,800.00
O3	\$12,455.99	12,280.00	\$166,573.88	164,200.00	\$179,029.87	176,480.00
PM2.5	\$32,681.79	725.70	\$437,053.32	9,700.00	\$469,735.11	10,425.70
SO2	\$34.39	687.52	\$459.84	9,200.00	\$494.23	9,887.52
PM10	\$13,085.95	4,200.00	\$175,011.64	56,040.00	\$188,097.59	60,240.00
CO2Seq	\$31,215.85	1,770,840.00	\$417,449.29	23,681,460.00	\$31,215.85	25,452,300.00
CO2Store*	\$1,085,198.56	61,618,880.00	\$14,525,724.45	824,028,900.00	\$15,610,923.01	885,647,780.00
					\$874,389.82	25,741,271.76

*Total stored - Not an annual rate